Ethernet in the First Mile – A Service Provider Perspective

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Important Carrier Considerations Relative to Deployment of New Technologies

Cost effective

- **Significant Market Potential**
- **Scaleable**
- **Multiple Sources**
- **Vendor Stability**
- **Interoperability**
- **Standard interfaces**
- **Long reach**

Operational Considerations

- **Compatibility w/legacy OSS**
  - Provisioning
  - Inventory
  - Billing
- **Spectrum Compatibility**
- **Reliability and Maintenance**
  - Environment Specifications
  - Remote test capabilities
  - Performance Monitoring Capabilities
  - Redundancy

Customer Satisfaction

- **Service Level Agreements**

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Ethernet in the First Mile - Overview

EFM over Fiber
- **P2P – Backhaul or direct access**
- **P2MP – EPON for FTTx**

Pair-bonded EFM
- **SHDSL PHY over Copper**
- **Symmetric**
- **Extend bandwidth off of fiber rings**
- **Bridge bandwidth gap between copper DS1s and OC-x**

EFM Copper (single pair)
- **Long Reach: SHDSL, Symmetric, no POTS, business**
- **Short Reach: VDSL, Symmetric or Asymmetric, high bandwidth, residential**
- **Ethernet access**

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Pair-bonding

Algorithms have been standardized in:
- **T1E1.4: ATM, Packet, TDIM**
- **ITU-T Q.4/SG15: G.bond (essentially the same as T1E1.4)**
- **IEEE 802.3ah: EFM**

TDIM: *protocol-independent bonding with inverse muxing*
- **Delivers Ethernet, ATM and TDM traffic over multiple DSL physical links**

ATM: *bonding multiple DSL links to transport ATM streams*
- **Less overhead than IMA**
- **Supports wide variety of configurations (# of pairs, disparate data rates, delay, dynamic removal and restoration of pairs)**

**Ethernet: *optimized for transport of Ethernet frames over xDSL***
- **Extends IEEE 802.3ah EFM copper technologies**
- **Supports SHDSL (G991.2), VDSL (G993.1), ADSL and other xDSL technologies as they emerge**

While algorithms are designed for pair-bonding across multiple pairs for symmetrical business applications, they can also be applied to 2-pair CPE for asymmetric residential applications
- **Currently requires 2 CPE chips (2-Port CPE chips currently not available)**
- **2-Port CPE cost is estimated to be 30% over single-port CPE**
- **Qwest has informed chip vendors of interest in 2-port CPE chips w/pair-bonding**
- **2-port ADSL2+ CPE chips would enable the triple-play**

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EoCU Benefits

- *Enables carriers to make more efficient use of capital through use of existing copper pairs to meet bandwidth needs of customers*

- *Enables quicker response time to customer requests*

- *Maximizes bandwidth capacity*

- *Spectrally friendly*

- *Provides increased reliability through the use of multiple pairs*

- *Enables end-to-end Ethernet services*

- *Facilitates migration from ATM to Ethernet networks*

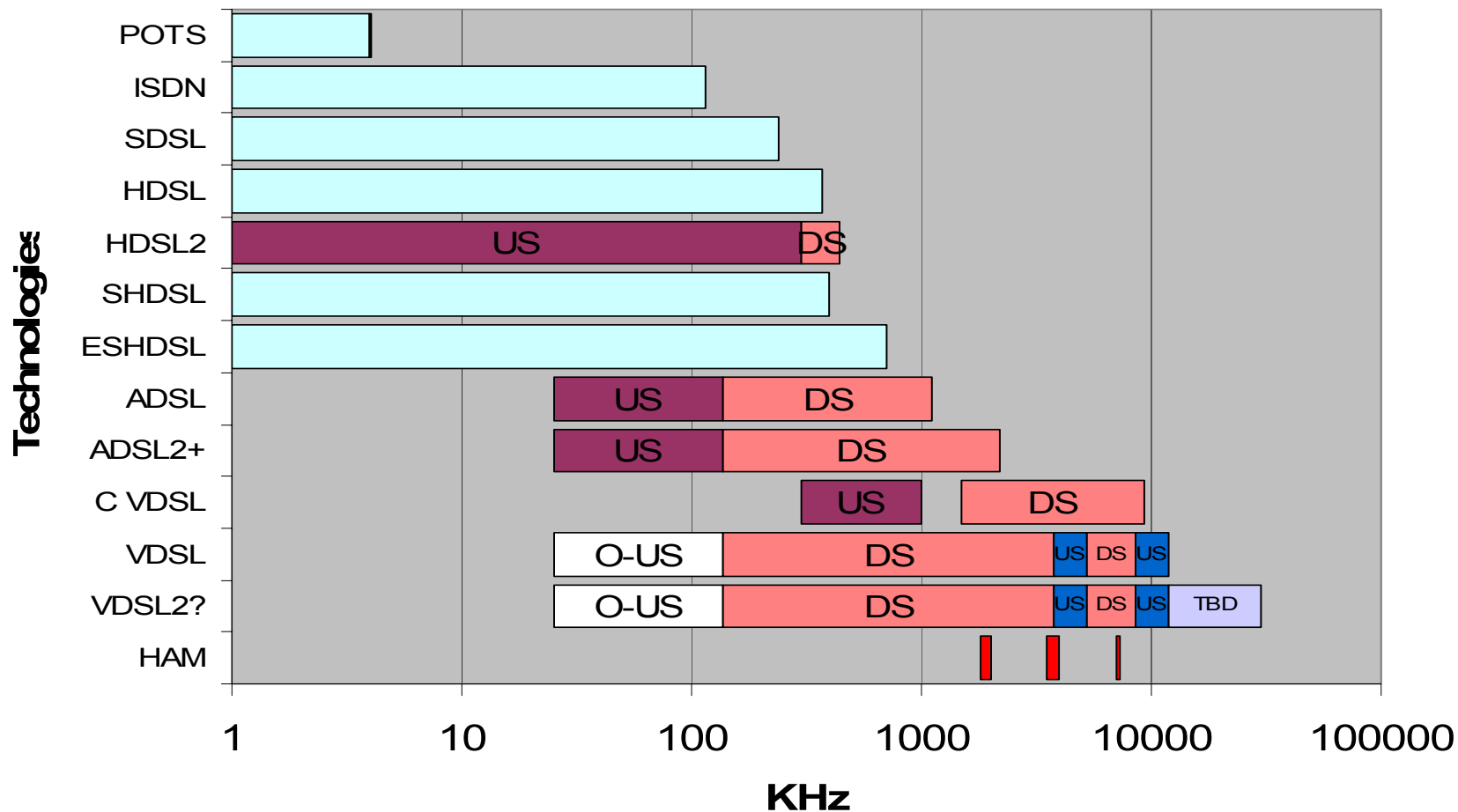- *Enables the ability to ride the Ethernet cost curve*

Graphics: Actelis

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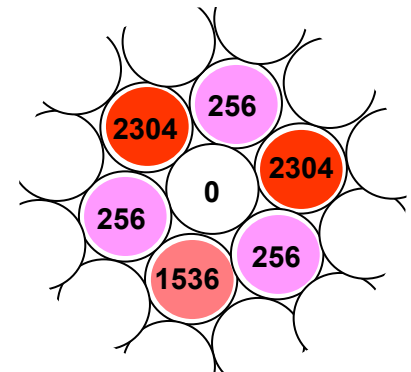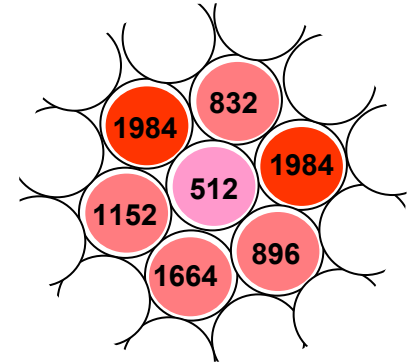
Qwest EFM Interest

Providing access to Qwest Products (MOE, QWave, etc., …)

Extend bandwidth off of fiber rings for business customers

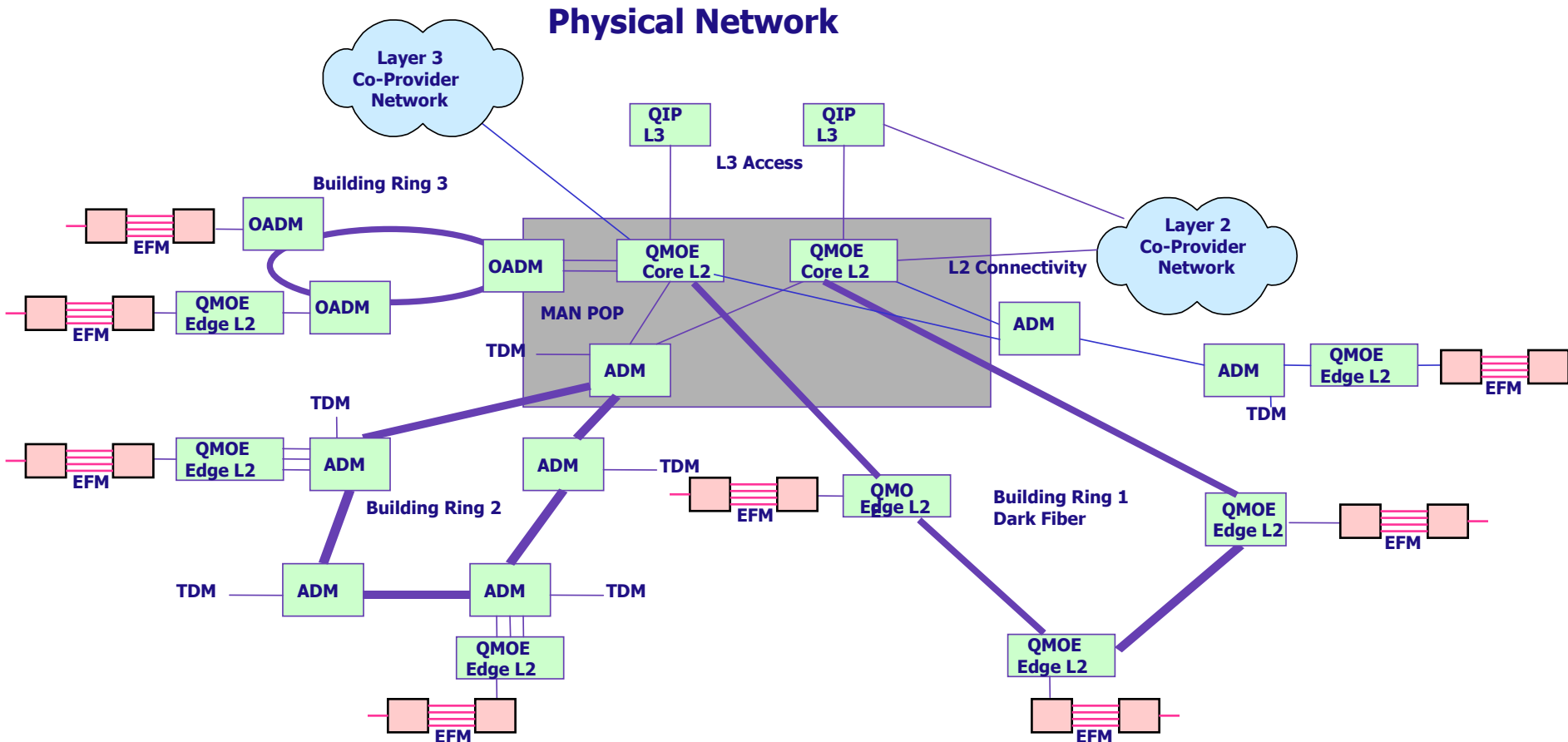**Expand backhaul capacity for access products**

Band Plans

Qwest Metro City Locations

Current as of September 20, 2004

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Rev 0.1 9/20/2004
Construction Dept:/Maps/Const/JJ/Metro City Locations/CorelDRAW v8

MOE Architecture w/EFM Access

Physical Network

EFM can be used to provide Ethernet access to the Qwest Metro Optical Ethernet Architecture
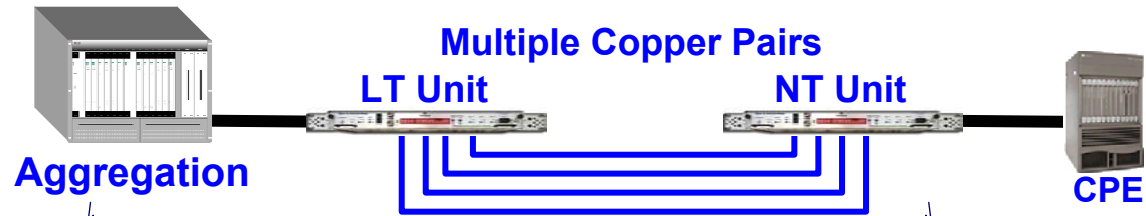
Sample Study of Buildings w/o Fiber

- **B**uildings in survey without fiber

	% of Total
0-6 K. Ft.	20%
6-10 K. Ft.	21%
10-15 K. Ft.	25%
15 K. Ft. >	34%

- **78% of buildings have > 25 spare copper pairs**
- **Opportunity space exists for the deployment of EoCU**

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Ethernet Backhaul/Access Architecture

**EFM
Pair-Bonded**
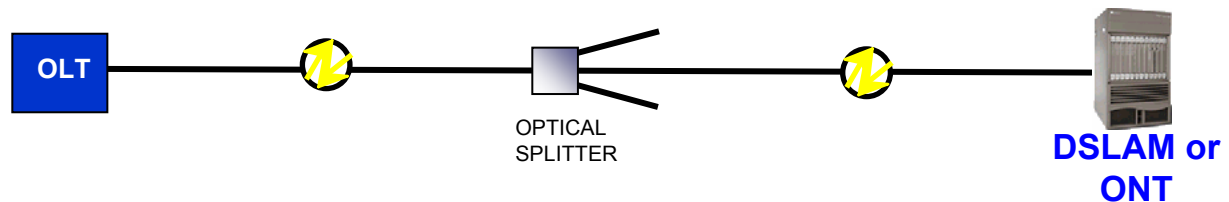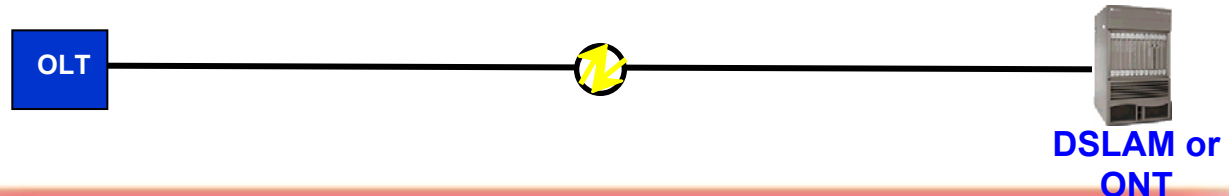
Aggregation

Multiple Copper Pairs

LT Unit

NT Unit

CPE

**Wireless
Alternatives**

DS1-DS3: WiMAX / WiFi
DS3-OC3: Proprietary Microwave
OC3-GigE: FSO → 70/80GHz Radio

**DSLAM or
CPE**

**EFM
P2MP Fiber**

OLT

OPTICAL
SPLITTER

**DSLAM or
ONT**

**EFM
P2P Fiber**

OLT

**DSLAM or
ONT**

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Ethernet over Copper
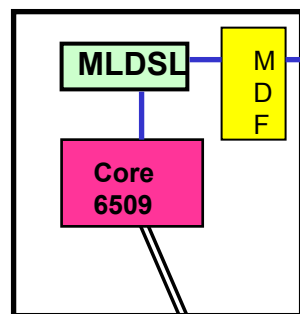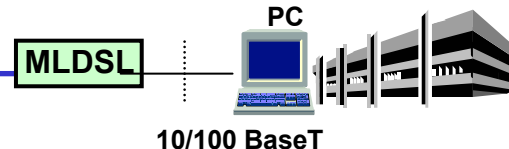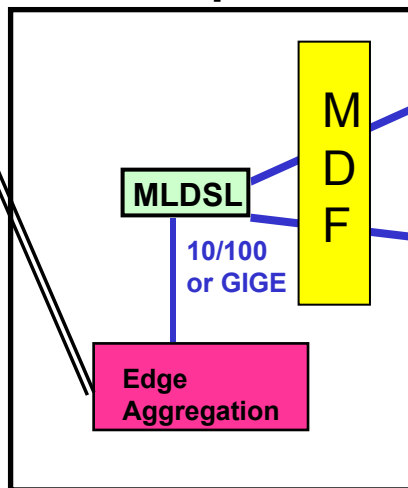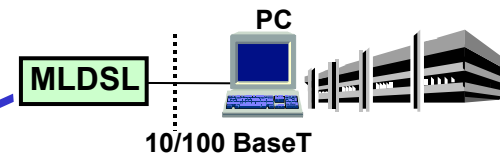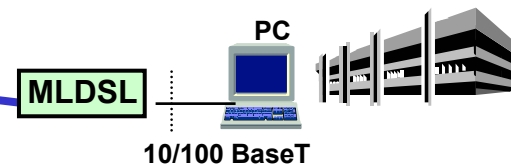
EFM Technical Trial Architecture

Technical Trial	*YE2004*
Ready Product for Deployment	*1Q05*
Deployment	*1Q05*

38 Mbps over 8 copper pairs

PC

ML 58

8 Copper Pairs
26 GA 1.91 K.Ft.

10/100 BaseT

M D F

ML 58

EoCU Multi Loop DSL with EFM bonding

ML 58

8 Copper Pairs
26 GA. 7.2 K.Ft.

PC

OSS   **10/100**

ML 58

10/100 BaseT

Ethernet Switch

22 Mbps over 8 copper pairs
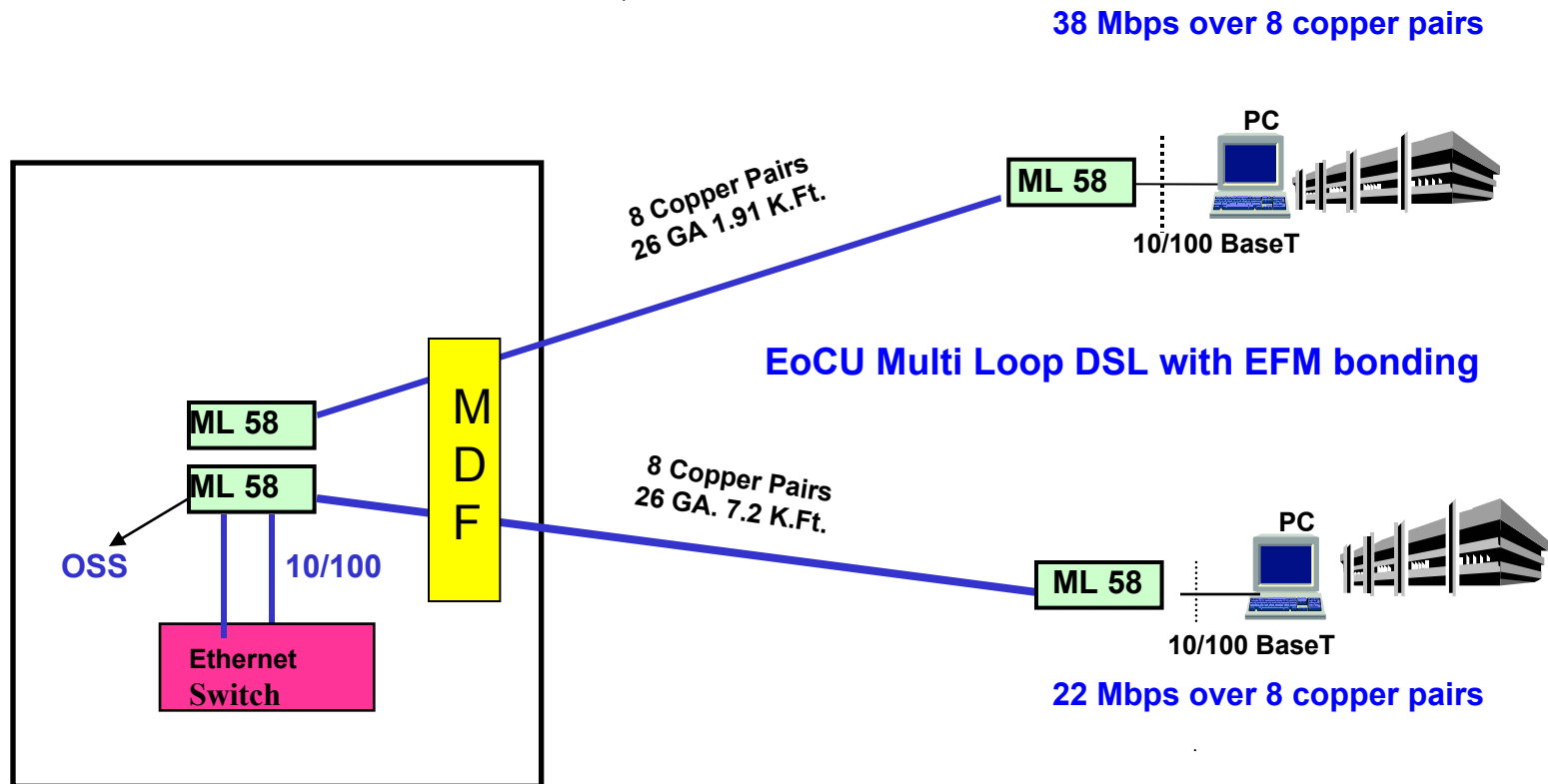
Summary

Evaluation and potential deployment of new and emerging technologies involves multiple considerations

EFM provides an access medium to enable end-to-end Ethernet services

In the absence of fiber, EFM extends more bandwidth towards the customer

EFM has potential